# Preferences for a third-trimester ultrasound scan in a low-risk obstetric population: a discrete choice experiment

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## Abstract

**Objective** Establish maternal preferences for a third-trimester ultrasound scan in a healthy, low-risk pregnant population.

**Design** Cross-sectional study incorporating a discrete choice experiment.

**Setting** A large, urban maternity hospital in Northern Ireland.

**Participants** One hundred and forty-six women in their second trimester of pregnancy.

**Methods** A discrete choice experiment was designed to elicit preferences for four attributes of a third-trimester ultrasound scan: health-care professional conducting the scan, detection rate for abnormal foetal growth, provision of non-medical information, cost. Additional data collected included age, marital status, socio-economic status, obstetric history, pregnancy-specific stress levels, perceived health and whether pregnancy was planned. Analysis was undertaken using a mixed logit model with interaction effects.

**Main outcome measures** Women's preferences for, and trade-offs between, the attributes of a hypothetical scan and indirect willingness-to-pay estimates.

**Results** Women had significant positive preference for higher rate of detection, lower cost and provision of non-medical information, with no significant value placed on scan operator. Interaction effects revealed subgroups that valued the scan most: women experiencing their first pregnancy, women reporting higher levels of stress, an adverse obstetric history and older women.

**Conclusions** Women were able to trade on aspects of care and place relative importance on clinical, non-clinical outcomes and processes of service delivery, thus highlighting the potential of

using health utilities in the development of services from a clinical, economic and social perspective. Specifically, maternal preferences exhibited provide valuable information for designing a randomized trial of effectiveness and insight for clinical and policy decision makers to inform woman-centred care.

## Introduction

Taking into account women's preferences in the design, planning and delivery of maternity services is a vital component to achieving woman-centred care. One additional service that has come under considerable debate in the literature is the use of a third-trimester ultrasound scan to identify growth-restricted infants in healthy, low-risk obstetric populations.[1–3] While women's views and expectations have been reported for current routine scans provided during the first and second trimester,[4–7] no data have been presented with regard to women's preferences for a routine scan in the third trimester.

Approximately 60 000 infants per annum are born growth restricted in the UK, 1000 of whom die as a result.[3] If detected in the antenatal period, clinicians are able to adjust management accordingly by monitoring the on-going pregnancy and inducing labour if there is evidence of risk to the mother or infant. Clinicians now possess the expertise in managing these infants, with survival rates dramatically improved over the past 20 years.[8] However, there remains a large proportion of growth-restricted infants that go undiagnosed until birth. The Royal College of Obstetricians and Gynaecologists indicated that the percentage of infants with intra-uterine growth restriction detected using current recommended guidelines is 33%.[9] In the majority of cases, intra-uterine growth-restricted infants that remain undiagnosed until birth are born to mothers who are experiencing a 'normal' pregnancy and who are, therefore, categorized throughout pregnancy as 'low risk'.[3] A review of the incidence of intra-uterine growth restriction in the United States found that growth restriction has a more detrimental effect on foetal morbidity in the third trimester and

called for an improvement in the surveillance and detection during this stage of pregnancy.[10] It is this need to improve the rate of detecting intra-uterine growth-restricted infants among low-risk pregnant women that gives rise to the proposal of a routine ultrasound scan during the third trimester. Since the 1980s, the use of ultrasound scans in pregnancy has become standard practice, favoured by obstetricians and women alike.[11] Certainly, the technology enables practitioners to obtain more accurate estimates of foetal weight and growth than tape measurement alone.[12] However, in the absence of a strong evidence base for clinical and cost-effectiveness,[13] ultrasound use in the third trimester has remained *ad hoc*.

The views of health service users need to be incorporated into the decision-making process by way of identifying needs, and prioritising and responding to those needs.[14] Prioritising healthcare services could be achieved by individualizing care, based not only on clinical indications, but also on consumer preferences. There is a clear recognition of the need for user engagement in the planning and delivery of health services in the United Kingdom.[15,16] This is deemed particularly important within maternity services, as highlighted within the United Kingdom government's guidance document and national framework for modern National Health Service's maternity services, Maternity Matters, which stipulates the importance of woman-focused and family-centred care that is patient-led.[17] Previous research into women's views and preferences for ultrasound scanning has focused on the early dating and anomaly scans.[4] A systematic review[7] on women's views of ultrasound scans assessed studies that used both quantitative and qualitative methods and reported several aspects of scanning which women valued, including seeing the baby, seeing movements and the reassurance received from

the scan. Incorporating these beneficial effects of ultrasound scanning into economic evaluations has been recommended.[18]

This current study aims to identify maternal preferences for a third-trimester scan and determine differences in preferences, using a discrete choice approach, which could assist in prioritizing the delivery of services to those who value them most. Discrete choice experiments are a preference elicitation methodology, which is being increasingly used in health services research to determine patient, health-care professional and policy maker preferences for a variety of health-care products and services.[19] A discrete choice experiment presents respondents with a series of hypothetical scenarios describing alternative options for a health-care service or treatment and asks them to choose which option they would prefer. Through respondents' stated preferences, the analyst is able to assess preferences for each attribute, along with trade-offs and willingness-to-pay estimates.[20] Examples within the area of maternity care have examined alternative packages of care,[21] antenatal screening for Down's syndrome[22] and intrapartum care.[23]

The primary objective for the current study was to determine maternal preferences for attributes of a third-trimester ultrasound scan with indirect willingness-to-pay estimates. Secondary objectives centred on identifying subgroups of women who exhibited higher preferences for the ultrasound scan.

## Methods

### Study sample and procedure

Data were collected from healthy, low-risk pregnant women attending a large, urban maternity unit in Northern Ireland using a cross-sectional observational study design. Two hundred women were approached during their first antenatal care appointment at 14–16 weeks' gestation, within the antenatal outpatients' clinic. Those who were over the age of 16, and self-reported that they were at low risk of developing complications, were invited to participate. At a

subsequent antenatal care appointment, between 22 and 28 weeks' gestation, participants provided consent and were asked to self-complete a questionnaire. A researcher was on hand throughout to answer queries. Participants who, on inspection of their maternity notes, were classified as being at high risk of complications were removed from the study. This latter classification of high-risk pregnancy was achieved using National Institute for Health and Clinical Excellence guidelines on the routine care of healthy pregnant women.[24] Ethical approval for the study was obtained from the Office for Research Ethics Committees Northern Ireland (REC reference number 05/NIR05/47), and research governance procedures were followed at the study site.

### Discrete choice experiment

A discrete choice experiment was designed to elicit preferences for an ultrasound scan carried out in the third trimester, following guidelines set down by Hensher *et al.*[25] A vital component in the experimental design stage is the identification of relevant attributes and levels, as these are the basis for individuals' choice behaviour and sources of preferences.[25] The aim for the researcher is to present individuals with a set of attributes and levels that are context specific and that maximize trade-offs between and within attributes, thus providing data that are most pertinent to informing policy makers and health-care practitioners.[20] The attributes and associated levels, which were used to describe the alternative scan options for this discrete choice experiment, were identified through a systematic literature search, in-depth discussion with health professionals and analysis of current practice. This included a review of qualitative and quantitative research studies exploring women's views and expectations of ultrasound scans in pregnancy.[4–7,26] Table 1 presents the full set of attributes and the corresponding levels used within the choice sets.

Definitions of each attribute were provided to respondents prior to completion of the discrete choice experiment. The first attribute,

**Table 1** The attributes and levels used to elicit preferences for an additional late pregnancy ultrasound scan

| Attribute | Levels |
|---|---|
| Non-medical information | Yes; No |
| Cost to you of the service | £0; £30; £80; £140 |
| Health-care professional | Consultant; Doctor; Midwife |
| Detection rate | 70%; 40% |

additional non-medical information, was described as the respondent being able to see their baby on the scan monitor and having the opportunity to confirm their baby's gender, if provided. The cost attribute was defined as the costs respondents would personally have to pay for the service, including the cost of the scan, travel expenses, possible child care costs and any lost income. The third attribute, health-care professional, represented the professional who would be undertaking the scan. The final attribute, detection rate, represented the ability of the scan to detect abnormal foetal growth. Respondents were explained that a small number of infants do not reach their growth potential and that the aim of an additional routine scan was to assess whether pregnancy was progressing as normal by checking the baby's health and environment.

Particular attention was given to the levels assigned to the detection rate and cost attributes, in order to ensure women were trading with realistic rates. For the detection rate attribute, levels were assigned following a review of the literature[9,18,27,28] and in consultation with two consultant obstetricians and a senior ultrasonographer. The aim of the attribute's levels is to acknowledge the sensitivity and specificity in the method by distinguishing between differences in detection rates when inherent factors are taken into account. These include, the training received, skill and experience of the scan operator, the capabilities of the scanning equipment and physique of the mother. For the cost of the service attribute, costs incurred by the National Health Service, as well as service users, were taken into account. These costs have previously been outlined in a comprehensive cost analysis of ultrasound scans during

pregnancy for both providers and users.[29] A lower limit was set at £0 to represent the United Kingdom's National Health Service premise of being free at the point of access and allow for respondents who objected to paying for antenatal care, that is protest bidders, a £30 level was set as an estimate of the average out-of-pocket expenses for women attending an antenatal appointment, £80 to represent the cost to health-care trusts for providing, a third routine scan and an upper limit of £140 was used to reflect the cost to women for accessing the service as a private antenatal patient.

The attributes and levels are presented to respondents in the form of pair-wise choice scenarios, asking them to indicate which scenario they prefer. A fractional factorial design type was chosen, with an orthogonal main effects plan, using the Statistical Package for the Social Sciences software,[30] generating 16 choice scenarios for participants that would maximize trade-offs between and within attributes. An unlabelled discrete choice experiment was designed, where the generic labels of Scan A and Scan B were used for the two alternatives, thus ensuring that respondents based their choice on the attributes alone. Women were also presented with a third option of having no scan. This third option enabled study participants to be presented with an unconditional choice set where they could opt out, if preferred. To ensure the attributes and levels were appropriate, the first 25 respondents were asked if there was anything else that they would consider to be important when choosing to have a third-trimester scan. None of these respondents identified any missing attributes; hence, no changes were made to the design of the experiment. An example of a scenario given to respondents is presented in Fig. 1.

## Maternal characteristics data

To identify heterogeneity in maternal preferences for the attributes of the ultrasound scan, by testing for interaction effects between the service attribute levels and maternal characteristics, additional information was collected that

| Scenario 1 | Scan A | Scan B | |
|---|---|---|---|
| Non-medical information | Yes | No | |
| Cost to you of service | £30 | £80 | **No Scan** |
| Health-care professionals | Midwife | Doctor | ☐ |
| Detection rate | 40% | 70% | |
| **Which scan do you prefer?** | ☐ | ☐ | |

**Figure 1** Example of a choice scenario.

focused on maternal demographics, details of obstetric history and current pregnancy perceptions. Regarding maternal demographics, maternal age, marital status and socio-economic status were recorded. A proxy for the latter item was derived from respondents' postcodes, which were transformed using a deprivation measure[31] that provides a weighted single score based on income, employment, health and disability, education, proximity to services, living environment and crime and disorder. Details of obstetric history were used to categorize women into three groups: women who had no previous pregnancies, those who had one or more previous pregnancies with no problems reported, and those who had one or more previous pregnancies with a problem reported. Obstetric history has been incorporated into previous research into women's expectations and experiences of antenatal care and is acknowledged as a significant factor in forming expectations of care.[5,32,33]

With regard to current pregnancy perceptions, respondents were asked how they felt about becoming pregnant using a standardized measure developed by the Pregnancy Risk Assessment Monitoring System in the United States[34] to determine whether a pregnancy was planned or not. Respondent's self-rated physical health was derived from a single measure, using a four-point scale ranging from poor to excellent. Finally, respondents completed the Prenatal Distress Questionnaire[35] to measure the levels of pregnancy-specific stress. Good test-retest reliability, internal consistency (Cronbach's alpha range of 0.78–0.90), convergent validity, construct validity and predictive validity have previously been reported.[36] For this study sample, Cronbach's alpha was 0.79. The additional information collected thus provided a context under which women were making their choice decisions within the discrete choice experiment.

## Data analysis

Choice data were effects coded and entered into NLOGIT 3.0[37] for analysis using a mixed logit model. Maternal characteristics that were collected in the form of categorical variables were dummy coded, while discrete continuous data, including maternal age, were maintained as such. The choice outcome is the variable that signifies the choice decision made for each scenario, and, as such, is the dependent variable within the model. The method of maximum likelihood estimation was used to estimate the model. Equation 1 presents the indirect utility (or value) function for an option *i:*

$$V_i = \beta_{1i}X_{1i} + \beta_{2i}X_{2i} + \beta_{3i}X_{3i} + \ldots + \beta_{Ki}X_{Ki} + \varepsilon_i \quad (1)$$

where $V_i$ is the observed utility for the *i*th option (ultrasound scan), estimated as a function of the attribute levels. For example, $\beta_{1i}$ is the estimated coefficient associated with attribute level $X_1$ and alternative *i*, representing the influence that the attribute level has on the choice decision made by respondents. $\varepsilon_i$ is the parameter estimate not associated with any

of the observed and measured attributes, which represents on average the role of all the unobserved sources of utility.

The possibility that maternal characteristics also had an effect on choice outcome was explored by estimating interaction effects with the attributes. Estimation of trade-offs between attributes was assessed using marginal rates of substitution, providing the indirect willingness-to-pay estimates for each attribute. A check was also made of the sign of the estimated coefficients for all attribute levels to verify whether they were consistent with *a priori* expectations, while the goodness-of-fit for the estimated model was addressed by examining the pseudo $R^2$ value.

## Results

A total of 200 women were informed of the current study and invited to participate. One hundred and eighty-three (92%) women consented and completed the discrete choice experiment. Two (1%) women were withdrawn following identification of being at high risk of complications, and a further 35 (19%) questionnaires were removed following internal validity testing through the inspection of responses for the occurrence of lexicographic preferences, that is, where respondents display 'irrational' responses, being unwilling to trade between the attributes and attribute levels. In particular, these respondents displayed evidence of non-compensatory decision making by refusing to trade between attributes, resulting in an inability to estimate marginal rates of substitution. Data analysis was conducted on a final sample of 146 (80%) women.

A summary of maternal characteristics of the final sample is presented in Table 2. Data on maternal age, marital status and parity were compared with regional statistics[38] and were found to be similar.

Table 3 provides the results of the mixed logit model, which included interaction effects with maternal characteristics. Marginal effects are represented by *Beta* coefficients, which indicate the attributes that had a significant impact

**Table 2** Maternal characteristics of study sample (*n* = 146)

| Characteristic | N (%) |
|---|---|
| Age (mean ± SD) | 28.88 ± 5.81 |
| Marital status | |
|   Married or living together as if married | 106 (72.6) |
|   Single or divorced | 40 (27.4) |
| Obstetric history | |
|   No previous pregnancies | 51 (35) |
|   Previous pregnancies with no problems reported | 65 (44.5) |
|   Previous pregnancies with problems reported | 30 (20.5) |
| Socio-economic status (*n* = 143) | |
|   1 (most deprived) | 69 (48.3) |
|   2 | 38 (26.6) |
|   3 | 28 (19.6) |
|   4 (least deprived) | 8 (5.6) |
| Pregnancy planning (*n* = 142) | |
|   I wanted to be pregnant sooner | 29 (19.9) |
|   I wanted to be pregnant then | 68 (46.6) |
|   I wanted to be pregnant later | 33 (22.6) |
|   I did not want to be pregnant then or anytime in the future | 12 (8.2) |
| Pregnancy-specific stress score (mean ± SD; range) | 15.42 ± 7.43; 0–46 |

on maternal preferences. Standard deviations for the main effects indicate the amount of preference heterogeneity observed in the study sample. If the standard deviation is statistically significant, it suggests that heterogeneity exists in the random parameter estimate. In other words, respondents exhibit individual-specific preferences that may be different from the study sample mean. The interaction effects between attributes and covariates then help to break down some of the heterogeneity observed and provide an explanation as to its presence or, rather, explain the relationship between respondents and their choices. Only interaction effects that were found to be statistically significant ($P \leq 0.01$) are presented.

Preference formation was as expected *a priori*, with women exhibiting a preference for the provision of non-medical information over not receiving it; no or low cost over high cost; and a higher rate for detecting abnormal foetal growth over a lower rate. The health-care professional providing the scan was not valued by

**Table 3** Results of the mixed logit model including interaction effects with maternal characteristics

| Variables | B (SE) | Standard deviation (SE) |
|---|---|---|
| Non-medical information | | |
|   Provided | 1.65* (0.63) | 1.09* (0.10) |
|   Not provided[1] | −2.22 | |
| Health-care professional | | |
|   Consultant | −0.29 (0.22) | <0.01 (0.82) |
|   Doctor | −0.16 (0.25) | 0.17 (0.81) |
|   Midwife[1] | −0.34 | |
| Cost | | |
|   £0 | 1.85* (0.36) | 0.18* (0.18) |
|   £30 | 0.65* (0.36) | 1.30* (0.10) |
|   £80 | −0.61 (0.37) | 0.03 (0.21) |
|   £140[1] | −3.50 | |
| Detection rate | | |
|   70% | 1.11* (0.06) | |
|   40%[1] | −1.11 | |
| No scan | −2.71* (0.09) | |
| Interaction effects | | |
|   Non-medical information × age | −0.04* (0.01) | |
|   Non-medical information × obstetric history | 0.48* (0.17) | |
|   Non-medical information × stress | −0.03* (0.01) | |
|   Non-medical information × socio-economic status | −0.01* (<0.01) | |
|   Cost × obstetric history | −0.23* (0.10) | |
|   Cost × marital status | 0.20* (0.08) | |
| No. of respondents | 146 | |
|   No. of options per choice scenario | 3 | |
|   No. of choice scenarios per respondent | 16 | |
| No. of observations per respondent | 48 | |
| Total No. of observations | 7008 | |
| Pseudo-$R^2$ | 0.47 | |

[1]Baseline level, with effects coding, is calculated as the negative sum of the estimated attribute levels and adjusted for preference heterogeneity where significant.
*$P < 0.01$.

the study participants ($P > 0.1$), suggesting that women did not value or did not consider this attribute within their decision-making process.

With regard to the interaction effects, only two attributes were influenced by maternal characteristics: non-medical information and cost. Four interaction effects with the non-medical information parameter were shown to be statistically significant ($P < 0.01$). The negative *Beta* coefficients exhibited by interactions with age, stress and socio-economic status indicate women's preferences for non-medical information increase as maternal age, pregnancy-specific stress and/or socio-economic status increase. However, the association with the latter maternal characteristic accounted for a minimal difference in utility ($\beta = -0.01$). With respect to the interaction effect of obstetric history for non-medical information, a positive coefficient implies that primiparous women and women who reported previous obstetric problems displayed greater preference for non-medical information than multiparous women who reported no previous obstetric problems ($\beta = 0.48$; $P < 0.01$).

Differences in the preferences held for the cost attribute were explained, in part, by interactions with two maternal characteristics: marital status and obstetric history ($P < 0.01$). The first, cost × marital status, suggested that women who were single or divorced were less sensitive to changes in the cost of the scan than their married or living together as if married counterparts. The second, cost × obstetric history, suggested that primiparous women or multiparous women who reported problems during previous pregnancies were also less sensitive to changes in the cost of the scan compared with multiparous women who reported no previous obstetric problems.

The overall preference by women for receiving a third-trimester scan was reiterated by the lack of preference for the opt-out alternative, which displayed the largest negative *Beta* coefficient ($\beta = -2.71$; $P < 0.01$). With regard to the overall fit of the model, the pseudo-$R^2$ value was reported at 0.47, indicating that it was able to explain nearly 90% of the variation in the data.[25]

To assess the relative impact of each attribute, marginal rates of substitution were calculated. Three attributes were included, with additional detection rate and non-medical

information used, in turn, as the denominator, and cost used as the numerator, so that the implicit price of each of these attributes could be calculated. The marginal rates of substitution are presented in Table 4.

These results represent the implicit price of a shift from not providing non-medical information to providing non-medical information and a shift from a lower rate of detection to a higher rate of detection, that is, other things being equal, respondents were willing to pay £80.67 for the scan to provide non-medical information and £54.68 to obtain a greater rate of detecting abnormal growth.

## Discussion

The results of this study suggest that women do value a third-trimester scan. The analysis of the discrete choice experiment demonstrated that the most important attributes for respondents were the additional detection rate that the scan could provide, the additional non-medical information and the cost to them of the service. This evidence supports similar findings from previous qualitative- and quantitative-based research on women's views and expectations of first and second trimester ultrasound scans.[4–7] Also of interest was the attribute representing the health-care professional who undertakes the ultrasound scan. This attribute was determined as insignificant in determining respondents' choice decisions, implying that it was not valued by respondents. A previous study on preferences for primary care consultations reported qualitative data and cited a series of reasons for 'irrational' choices with respect to the health-care professional including, information from other choices, additional assumptions made, own experience/protest

**Table 4** Respondents' marginal rates of substitution between cost of a third-trimester scan and other attributes

| Preferred attribute level | Willingness to pay, mean |
|---|---|
| Non-medical information provided | £80.67 |
| 70% Additional detection rate | £54.68 |

answers, consistent underlying preferences, indifference, random error and contradictory preferences.[39]

When maternal characteristics were included in the modelling of the choice decisions, several associations with preferences were uncovered. Regarding the cost attribute, respondents who reported a poor obstetric history and those who were single or divorced were less sensitive to changes in the cost of the scan and, therefore, were willing to pay more. It is perhaps intuitive that those who have experienced problems during previous pregnancies would value an additional scan more highly. In addition, the willingness of single or divorced women to pay the higher levels of cost indicates perhaps a greater desire for reassurance derived from the service in these groups. For the attribute representing the scan's ability to detect abnormal growth, no significant associations were found in relation to any maternal characteristic, that is all women valued this attribute equally. This demonstrates women's preference for affirmation of their baby's health, irrespective of individual differences.

Ultimately, differences across women's preferences were most evident regarding the provision of non-medical information. This attribute presents a tangible aspect of scanning, which allows women to see their baby on the monitoring screen, see the baby's heartbeat and movements, and possibly confirm the baby's gender. These latter attributes are unique to ultrasound scanning. While current recommended techniques, such as symphysis-fundal height measurement, are of equivalent clinical value for detecting abnormal growth,[24] they do not provide women with an opportunity to observe their baby. This research reiterates the importance of the value of non-medical outcomes to patients, a factor that has increased in importance within the health economics literature during the past 10 years,[40] but has had less impact in the wider literature on health services.[41]

This is the first study, to the authors' knowledge, that provides indirect willingness-to-pay estimates by women for attributes of a

pregnancy scan in the third trimester. The 'cost' attribute represented a proxy for value and was subsequently used to assess the implicit price of the non-medical information and detection rate attributes through marginal rates of substitution. However, Slothuus Skjoldborg and Gyrd-Hansen[42] note that willingness-to-pay estimates gained from respondents through discrete choice experiments are intertwined with the cost attribute of the service and, in particular, the levels offered as a choice. Individuals are influenced and guided by the cost limits presented to them in the exercise and, therefore, may not be able to demonstrate their true valuation of the service if the cost variable has upper and lower limits that do not reflect their own.[43] In the current study, the discrete choice experiment used a range of levels that were commensurate with actual costs reported, as opposed to providing an extreme level to attempt to identify the true limit or benefit women have for the service. While the results showed that women had greater willingness-to-pay estimates for obtaining non-medical information than for increasing the detection rate from 40 to 70%, the reader should be aware that these prices represent substitutions within the attributes, as opposed to across attributes.

Typically, willingness-to-pay estimates for publicly funded health services have been used to report relative preferences for different services or service configurations (see Deverill *et al.*,[21] Pitchforth *et al.*,[23] and Bijlenga *et al.*,[44] for recent examples within obstetric care). Shackley and Donaldson[45] referred to the problem of how to use the information gained from willingness-to-pay studies within policy decision making in a publicly financed environment. They concluded that any elicitation must employ methods that realistically reflect the circumstances of service provision within the National Health Service, so that health-care decision makers can make effective use of any findings. More recently, there has been a push towards utilizing the information directly in economic evaluations of health technologies or interventions.[20] The use of discrete choice experiments, as a possible means of providing

relevant information for inclusion in cost-benefit, cost-effectiveness and cost-utility studies, is growing in momentum.[20,46,47] In this particular instance, a full economic evaluation of a third-trimester ultrasound scan in pregnancy should incorporate maternal costs/benefits. It is clear from this study that respondents were capable of understanding the hypothetical nature of the discrete choice experiment without introducing protest bids or strategic biases, which would have resulted in respondents showing no regard for the personal cost of the scan. This study sample was able to use the cost attribute to value the attributes and attribute levels describing the additional antenatal scan.

## Study limitations

With regard to sampling methods, the authors acknowledge the limitations, in terms of sample representativeness, of using a convenience sample derived from the antenatal outpatients' clinic of a regional maternity unit. Regional statistics[38] were obtained for maternal age, marital status and parity, which confirmed a representative sample with respect to these factors. Future research could explore the implications of broadening the sample to include private patients or a range of individuals with a particular stake or interest in the additional service (obstetricians, midwives, fathers and families) or even the general public, which would be warranted within a publicly funded health service. Most recently, Bijlenga *et al.*,[44] elicited direct and indirect willingness-to-pay estimates for obstetric care from a sample of laypersons.

The indirect willingness-to-pay estimates derived from this discrete choice experiment must be viewed simplistically as preferences for the related attributes, and not as an actual price that women would pay for such a scan. The estimates were invariably influenced by the upper attribute level of £140, which subsequently limited the maximum valuation respondents could exhibit. A previous study, published in 1985, to identify direct willingness-to-pay estimates for ultrasound scans in

low-risk pregnancy placed no limitations on price using an open-ended contingent valuation method and, as a result, reported mean estimates of $706.[48] Future research could perhaps explore a range of techniques to calculate and compare direct and indirect willingness-to-pay estimates for a third-trimester scan. Information on direct willingness-to-pay measures would require an approach that fully informed participants of the medical and non-medical capabilities of ultrasound scans during the third trimester, in addition to the capabilities of current and alternative techniques to detect abnormal growth, such as abdominal palpation and symphysis-fundal height measurement. An informed choice could then be made on the price they would actually be willing to pay for this service. Any pricing would also have to consider the full financial resource implications to antenatal services of providing an additional routine scan to healthy, low-risk pregnant women.

## Conclusion

The research presented in this article engaged maternity service users, giving an opportunity for women to express their preferences for a third-trimester ultrasound scan and identified the relative importance placed on clinical and non-clinical outcomes, along with processes of service delivery. The results provide valuable insight for clinical and policy decision makers and should enhance clinicians' understanding of women's priorities for ultrasound scans in pregnancy. In particular, the high valuation by healthy, low-risk women in this study for non-medical information emphasizes the importance of non-clinical outcomes, which historically have been undervalued in maternity services research. In the field of health valuation and utilities, non-clinical outcomes are an important feature of patient-reported outcome measures. Incorporating these aspects into shared decision making is essential, if public involvement in the development of services from a clinical, economic and social perspective is to be achieved. Findings from the current study

could be used to inform the design of a large-scale randomized controlled trial on the clinical and cost-effectiveness of a third-trimester ultrasound scan, by providing data on both the clinical and non-clinical outcomes as benefits to women.

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## Conflicts of interest

No conflicts of interest are declared.

## References

1 Figueras F, Gardosi J. Intrauterine growth restriction: new concepts in antenatal surveillance, diagnosis, and management. *American Journal of Obstetrics and Gynecology*, 2011; **204**: 288–300.
2 Bricker L, Mahsud-Dornan S, Dornan JC. Detection of foetal growth restriction using third trimester ultrasound. *Best Practice & Research. Clinical Obstetrics & Gynaecology*, 2009; **23**: 833–844.
3 McKenna D, Dornan JC. Who's looking for the high-risk fetus in the low-risk mother? *The Obstetrician & Gynaecologist*, 2005; **7**: 50–51.
4 Georgsson Ohman S, Waldenstrom U. Second-trimester routine ultrasound screening: expectations and experiences in a nationwide Swedish sample. *Ultrasound in Obstetrics and Gynecology*, 2008; **32**: 15–22.
5 Lalor JG, Devane D. Information, knowledge and expectations of the routine ultrasound scan. *Midwifery*, 2007; **23**: 13–22.
6 Gudex C, Nielson BL, Madsen M. Why women want prenatal ultrasound in normal pregnancy. *Ultrasound in Obstetrics and Gynecology*, 2006; **27**: 145–150.
7 Garcia J, Bricker L, Henderson J *et al.* Women's views of pregnancy ultrasound: a systematic review. *Birth*, 2002; **29**: 225–250.
8 Drife J. Can we reduce perinatal mortality in the UK? *Expert Review of Obstetrics & Gynecology*, 2008; **3**: 1–3.
9 RCOG. *Royal College of Obstetricians and Gynaecologists Guideline No. 31: The Investigation and Management of the Small-for-Gestational-Age Fetus.* London, UK: RCOG, 2002.

10 Gilbert WM, Danielsen B. Pregnancy outcomes associated with intrauterine growth restriction. *American Journal of Obstetrics and Gynecology*, 2003; **188**: 1596–1601.

11 Harris G, Connor L, Bisits A, Higginbotham N. Seeing the baby: pleasures and dilemmas of ultrasound technologies for primiparous Australian women. *Medical Anthropology Quarterly*, 2004; **18**: 23–47.

12 Resnik R. Intrauterine growth restriction. *Obstetrics and Gynecology*, 2002; **99**: 490–496.

13 Bricker L, Neilson JP, Dowswell T. *Routine Ultrasound in Late Pregnancy (After 24 weeks' Gestation)*. Chichester, UK: John Wiley & Sons, Ltd, The Cochrane Library, 4, 2008.

14 Dolan P, Cookson R, Ferguson B. Effect of discussion and deliberation on the public's views of priority setting in health care: focus group study. *BMJ*, 2009; **318**: 916–919.

15 Department of Health. *Equity and Excellence: Liberating the NHS*. UK: DoH, 2010.

16 Department of Health. *Liberating the NHS: Legislative Framework and Next Steps*. UK: DoH, 2010.

17 Department of Health. *Maternity Matters: Choice, Access and Continuity of Care in a Safe Service*. UK: DoH, 2007.

18 Bricker L, Garcia J, Henderson J *et al*. Ultrasound screening in pregnancy: a systematic review of the clinical effectiveness, cost-effectiveness and women's views. *Health Technology Assessment*, 2000; **4**: 1–205.

19 Ryan M, Scott D, Reeves C. Eliciting public preferences for health care: a systematic review of techniques. *Health Technology Assessment*, 2001; **5**: 1–194.

20 Lancsar E, Louviere J. Conducting discrete choice experiments to inform healthcare decision making. A user's guide. *Pharmacoeconomics*, 2008; **26**: 661–677.

21 Deverill M, Lancsar E, Snaith VBA, Robson SC. Antenatal care for first time mothers-a discrete choice experiment of women's views on alternative packages of care. *European Journal of Obstetrics, Gynecology, and Reproductive Biology*, 2010; **151**: 33–37.

22 Bishop AJ, Marteau TM, Armstrong D *et al*. Women and health care professionals' preferences for Down's Syndrome screening tests: a conjoint analysis study. *BJOG*, 2004; **111**: 775–779.

23 Pitchforth E, Watson V, Tucker J *et al*. Models of intrapartum care and women's trade-offs in remote and rural Scotland: a mixed-methods study. *BJOG*, 2007; **115**: 560–569.

24 National Collaborating Centre for Women's and Children's Health. *Antenatal Care: Routine Care for the Healthy Pregnant Woman*. London, UK: RCOG Press, 2008.

25 Hensher DA, Rose JM, Greene WH. *Applied Choice Analysis: A Primer*. New York: Cambridge University Press, 2005.

26 Ekelin M, Crang-Svalenius E, Dykes A-K. A qualitative study of mothers' and fathers' experiences of routine ultrasound examination in Sweden. *Midwifery*, 2004; **20**: 335–344.

27 Confidential Enquiry into Stillbirths and Deaths in Infancy. *Eighth Annual Report*. London, UK: CESDI, 2001.

28 Skovron ML, Berkowitz GS, Lapinski RH, Kim JM, Chitkara U. Evaluation of early third-trimester ultrasound screening for intrauterine growth retardation. *Journal of Ultrasound in Medicine*, 1991; **10**: 153–159.

29 Henderson J, Bricker L, Roberts T, Mugford M, Garcia J, Neilson J. British National Health Service's and women's costs of antenatal ultrasound screening and follow-up tests. *Ultrasound in Obstetrics and Gynecology*, 2002; **20**: 154–162.

30 SPSS Inc. *SPSS® for Windows 13.0*. Chicago, IL, USA: SPSS Inc., 2005.

31 Northern Ireland Statistics & Research Agency. *Northern Ireland Multiple Deprivation Measure 2005*. Belfast, NI: NISRA, 2005.

32 Brisch KH, Munz D, Bemmerer-Mayer K, Kachele H, Terinde R, Kreienberg R. Ultrasound scanning for diagnosis of foetal abnormality and maternal anxieties in a longitudinal perspective. *Journal of Reproductive and Infant Psychology*, 2002; **20**: 223–235.

33 Ayers S, Pickering AD. Women's expectations and experience of birth. *Psychology & Health*, 2005; **20**: 79–92.

34 Centers for Disease Control and Prevention. *Pregnancy Risk Assessment Monitoring System Phase 5 (2005–2008) Core Questionnaire*. Atlanta, GA: Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention. Available at: http://www.cdc.gov/prams/PDF/Phase5_CoreQuestions.pdf, accessed 17 April 2012.

35 Yali AM, Lobel M. Coping and distress in pregnancy: an investigation of medically high risk women. *Journal of Psychosomatic Obstetrics and Gynaecology*, 1999; **20**: 39–52.

36 Alderdice F, Lynn F, Lobel M. A review and psychometric evaluation of pregnancy-specific stress measures. *Journal of Psychosomatic Obstetrics and Gynaecology*, 2012; **33**: 62–77.

37 Greene WH. *NLOGIT Version 3.0*. New York: Econometric Software Inc., 2002.

38 Northern Ireland Statistics & Research Agency. *Registrar General Annual Report 2006: Section 3 Births*. Belfast, NI: NISRA, 2006.

39 San Miguel F, Ryan M, Amaya-Amaya M. 'Irrational' stated preferences: a quantitative and qualitative investigation. *Health Economics*, 2005; **14**: 307–322.

40 Ryan M, Watson V, Entwistle V. Rationalising the 'irrational': a think aloud study of discrete choice experiment responses. *Health Economics*, 2008; **18**: 321–326.

41 McIntosh E. Using discrete choice experiments within a cost-benefit analysis framework: some considerations. *Pharmacoeconomics*, 2006; **24**: 855–868.

42 Slothuus Skjoldborg U, Gyrd-Hansen D. Conjoint analysis. The cost variable: an Achilles' heel? *Health Economics*, 2003; **12**: 479–491.

43 Ryan M, Ratcliffe J. Some issues in the application of closed-ended willingness to pay studies to valuing health goods: an application to antenatal care in Scotland. *Applied Economics*, 2000; **32**: 643–651.

44 Bijlenga D, Bonse GJ, Birnie E. Eliciting willingness to pay in obstetrics: comparing a direct and an indirect valuation method for complex health outcomes. *Health Economics*, 2011; **20**: 1392–1406.

45 Shackley P, Donaldson C. Willingness to pay for publicly-financed health care: how should we use the numbers? *Applied Economics*, 2000; **32**: 2015–2021.

46 Flynn TN. Using conjoint analysis and choice experiments to estimate QALY values: issues to consider. *Pharmacoeconomics*, 2010; **28**: 711–722.

47 Ungar WJ. Challenges in health state valuation in paediatric economic evaluation. *Pharmacoeconomics*, 2011; **29**: 641–652.

48 Berwick DM, Weinstein MC. What do patients value? Willingness to pay for ultrasound in normal pregnancy. *Medical Care*, 1985; **23**: 881–893.